Status Update | Sept Plenary 2023

TSN Profile for Aerospace

Status Update

Abdul Jabbar
GE Research

Objective

- ***Review progress of profile development***
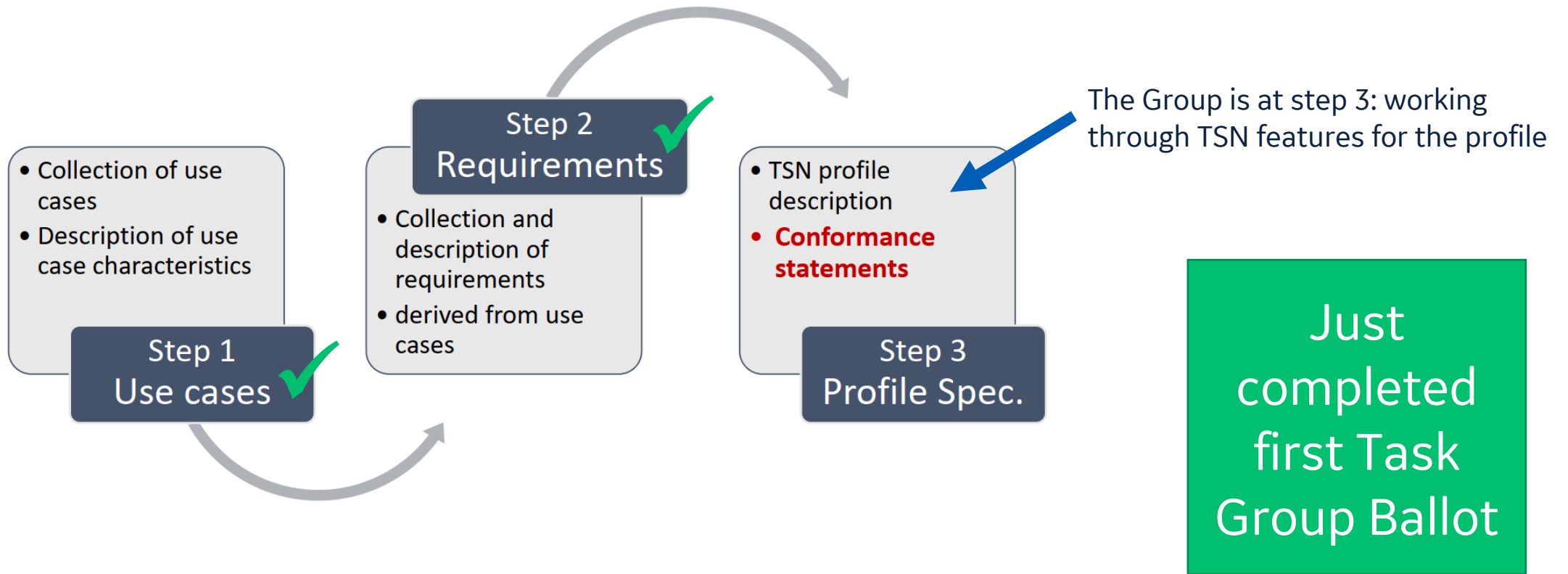
IEEE P802.1DP/SAE AS 6675
TSN for Aerospace Onboard Ethernet Communications

- Joint project between IEEE 802.1 TSN TG and SAE AS1-A2 Committee (Dual Logo Standard)

- Combining SAE committee's domain expertise with IEEE task group's TSN expertise

- Developed through IEEE meeting room; requires approval from both IEEE and SAE

- Co-Chairs: Janos Farkas and Abdul Jabbar

- Editor: Abdul Jabbar

- PAR Approval: Dec 2020

- PAR Expiration date: Dec 2024

- Biweekly meetings: Wednesdays 10:00 AM to 12:00 PM ET

- Face-to-Face Meetings: 3 IEEE Interim Sessions, 3 IEEE Plenary Sessions, 2 SAE meetings

- Participation from Aerospace OEMs, Tier 1/2/3 suppliers, TSN Experts

https://1.ieee802.org/tsn/802-1dp/

https://standardsworks.sae.org/standards-committees/1a-avionic-networks-committee#wips

TSN Aerospace Profile Development

• Collection of use cases
• Description of use case characteristics

**Step 1
Use cases** ✓

**Step 2
Requirements** ✓

• Collection and description of requirements
• derived from use cases

• TSN profile description
• **Conformance statements**

**Step 3
Profile Spec.**

The Group is at step 3: working through TSN features for the profile

Just completed first Task Group Ballot

Reference: IEEE 802.1 TSN Profiles, Janos Farkas
https://www.ieee802.org/1/files/public/docs2021/dp-farkas-TSN-profiles-0221-v01.pdf

Status Summary

- Use cases collected and requirements derived

- Two profile approach is being adopted – Synchronous Profile and Asynchronous Profile

- Functions needed for aerospace networks are identified

- TSN features/standards necessary to support the necessary functions are being discussed

- Attention is being paid to the safety critical nature of aerospace and regulatory certification needs

- Scope, direction, and approach are well aligned with the aerospace industry and committee participants

- First draft completed and put through first task group ballot. Ongoing comment resolution.

Use Cases Documented
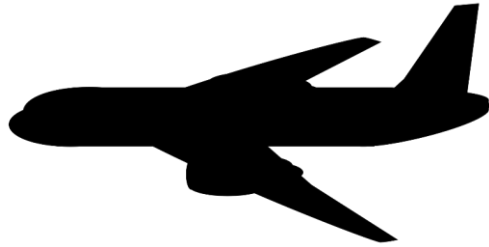
Commercial/Civil Aircraft
- Aircraft Control Domain Network (ACD) *small and large passenger aircraft*
- Cabin Network (ACD, AISD, PIESD) *large passenger aircraft*
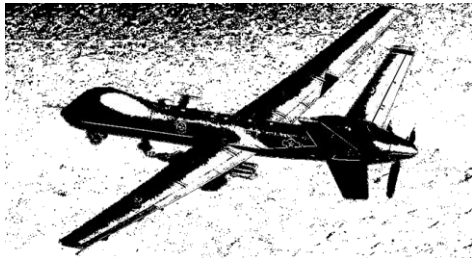

Fixed Wing Military Aircraft
- Mission Network (small, combat, large)
- Flight Network (VMS)
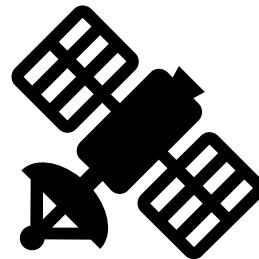- Fiber Channel over TSN (convergence)

Rotary Wing Military Aircraft
- Mission Network
- Flight Network

Unmanned Military Aircraft Network

Satellite
- Platform Network
- Payload Network

11 detailed use cases contributed by OEMs and tier1/2/3 suppliers documenting both network and traffic characteristics

Reference: AEROSPACE TSN USE CASES, TRAFFIC TYPES, AND REQUIRMENTS, SAE AS1-A2 committee
https://www.ieee802.org/1/files/public/docs2021/dp-Jabbar-et-al-Aerospace-Use-Cases-0321-v06.pdf

Two Profile Approach: Notional applications

Asynchronous Profile
targets current Ethernet based use cases

- Asynchronous with slower cycle times (> 50 msec)
- Latency bounded with acceptable delay variation (jitter) up to latency bound
- Comfortable with rate constrained shaping
- Controlled network – no undefined traffic on the network
- Highly static – designed, analyzed, configured well ahead of operation
- Certification burden is significant – simplicity is valuable
- Simple network redundancy (end system based)

Asynchronous profile to provide an equivalent network solution

Synchronous Profile
targets current non-Ethernet and future use cases

- Segmented/partitioned subsystems
- Synchronous with cycle times in the order of 1 msec. Future use cases with sub-millisecond cycle times
- Sensitive to latency (or deadline) and delay variation (jitter)
- Convergence of mixed critical traffic
- Interoperability of legacy buses on top TSN backbone
- Platform wide clock time distribution
- Potential for dynamic (re)configuration
- Flexible redundancy

Synchronous profile to provide an Ethernet based converged network solution

Required Functions for Aerospace Profiles
Status

Functions	Profile Specification	Status (open items)
Time Synchronization	802.1AS-2020*	Fault tolerance – availability and integrity
Egress Traffic Shaping	Credit Based Shaper Time Aware Shaper*	No significant open issues
Redundancy	Frame Replication and Elimination	Minor: FRER for integrity by sending multiple frames to the application
Ingress Policing	Per-Stream Filtering and Policing	No significant issues. Small differences in the filters compared to A664.
Stream Separation	Stream identification, transformation, and separation	Aerospace bridges may require significantly higher number of stream entries.
Configuration	Fully centralized, Yang models	YANG model for CBS Device Data Sheets
Forwarding	Per-stream static forwarding	Minor: Policy-based forwarding with TCAM will not be standardized for brownfield use cases
Management and Monitoring	Required error, fault, and performance metrics	Mandatory objects for Time Synchronization, Stream Separation, and base forwarding/queueing

Only applicable to Synchronous profile

Next Steps

1. Fault tolerant time synchronization – Availability and integrity

2. Monitoring Objects/Parameters – Need contributions for remaining features

3. Comment resolution for TG Ballot 1

Both SAE and 802.1 is contribution driven – need contributions to advance the specification